REPORT DOCUMENTATION PAGE

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ı-0188

AFRL-SR-BL-TR-01-

00(62

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE

3. ı.

Final 15 Jun 95 to 14 Jun 98

4. TITLE AND SUBTITLE
AASERT-95 Femtosecond Near-Field Spin Microscopy of Magnetic/Superconducting Heterostructures

5. FUNDING NUMBERS
3484/US
61103D

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Air Force Office of Scientific Research
801 N. Randolph Street
Arlington, VA 22203-1977

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
F49620-95-1-0434

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
Unlimited Distribution

12b. DISTRIBUTION CODE

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH (AFOSR)
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13. ABSTRACT *(Maximum 200 words)*

Under the AASERT program, our student developed magnetically active II-VI diluted magnetic semiconductor (DMS) surface quantum well "substrates" upon which to epitaxially grow and pattern ferromagnetic Fe films in order to produce spin-dependent potentials. This material phase produced a variety of flux-focusing magnetic patterns including planar wedges and variable-spaced single domain particle arrays with nominally 0.1-0.5 micron feature sizes. These patterns are designed to create a field-driven spin-dependent energy landscape for optically-pumped or doped carriers and provide a basis for spatial measurements of electronic spin transport.

14. SUBJECT TERMS

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

AFOSR-AASERT Final Technical Report
Grant #F49620-95-1-0434

Femtosecond Near-field Spin Microscopy of Magnetic/Superconducting Heterostructures

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In contrast to embedding magnetic moments within a semiconductor heterostructure, it is important to demonstrate an ability to guide spin-dependent transport using field gradients from magnetic films grown upon a semiconductor heterostructure. The spin-dependent properties of these magnetically-patterned nanostructures is presently being resolved using both near-field scanning optical microscopy (NSOM) and magnetotransport studies. Under the AASERT program, our student developed magnetically active II-VI diluted magnetic semiconductor (DMS) surface quantum well "substrates" upon which to epitaxially grow and pattern ferromagnetic Fe films in order to produce spin-dependent potentials. This material phase produced a variety of flux-focusing magnetic patterns including planar wedges and variable-spaced single domain particle arrays with nominally 0.1-0.5 micron feature sizes. These patterns are designed to create a field-driven spin-dependent energy landscape for optically-pumped or doped carriers and provide a basis for spatial measurements of electronic spin transport. Both insulating and conducting substrates have been prepared for the optical and transport measurements.

We have grown hybrid ferromagnetic-DMS quantum well structures by depositing typically 50 nm thick epitaxial films of Fe on top of a single ~ 12 nm quantum well containing 3 monolayers of Mn ions. Figure 1 shows an example of a recent result in collaboration with Dr. Gary Prinz of the Naval Research Laboratory. This wet-etched single-crystal Fe film was processed using a newly developed chemical technique, *without any electronic degradation of the underlying semiconductor heterostructure.*

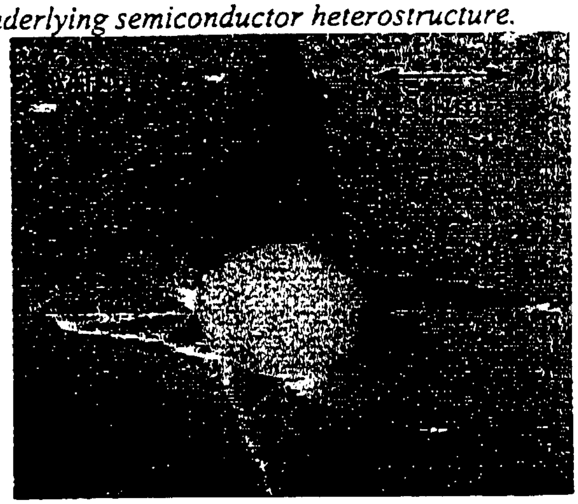

Fig. 1. Magnetic force microscopy image of a 5 micron hole etched through a 50 nm-thick crystalline Fe film grown upon a 12 nm ZnSe/ZnCdSe quantum well containing 12-1/4 monolayer MnSe planes (a digital magnetic heterostructure). At B=0, star-shaped domain walls form to minimize the free-energy of the in-plane field, creating large field gradients at the edges of the hole. For B>3 G, the domain walls sweep away leaving very large gradients around